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The impact and lessons learnt from the COVID-19 pandemic on a UK Burns Centre

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ABSTRACT

The COVID-19 pandemic has dramatically impacted healthcare provision in the UK and burns services have had to adapt to ensure the continuity of a safe care. As we return to "normality" we reflect on lessons learnt from our response to this pandemic.

A service evaluation was performed from patient notes between March 23rd and May 8th 2020 and an anonymous survey given to patients attending outpatient appointments.

258 patients were referred to our burns service and 148 patients completed the survey. Eleven burns were caused by treatment or prevention of COVID-19. Patients delayed seeking medical attention due to concern of catching COVID-19 (36% adults, 8% children). There was a delay in referral of 17 patients despite them fulfilling the referral criteria. Infection rates were higher following delayed presentation (21% vs 6%). The majority of burns were managed conservatively (237/258). Dressing changes were performed at home by 32% of patients. The outreach team treated 22 patients.

During the pandemic telemedicine has improved the efficiency of outpatient burn care and outreach nurses have enabled treatment of vulnerable patients. More must be done to raise public awareness of preventable causes of burn injury and to reassure them to seek help when burns occur.

1. Introduction

The novel coronavirus (COVID-19) was first described in Wuhan China at the end of 2019, by the 11th of March 2020 the WHO had declared it a global pandemic [1]. The first cases of COVID-19 in England were detected on the 31st of January 2020 [2] and the first COVID-19 related death in England was reported on the 5th of March 2020 [3]. As cases continued to rise and the country went into lockdown [4] significant changes occurred within NHS hospitals as steps were taken to reduce the risk of transmission to patients, and to re-direct resources to support intensive care environments. Elective operating and outpatient appointments were suspended, visitors banned from visiting the hospital and changes made to the provision of emergency operating lists. The British Association of Plastic Reconstructive Aesthetic Surgeons (BAPRAS) launched a campaign to reduce avoidable injuries in the home [5].

Burns Centres such as ours work closely as a multidisciplinary team including intensive care doctors and nurses. Our staff have skill sets invaluable during times of increased pressure on intensive care. In our Trust, nurses,

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physiotherapists and junior doctors were redeployed to ITU to contribute to the pandemic effort and burns consultants contributed to the delivery of a surgical tracheostomy service. At the same time steps were taken to ensure continuity of delivery of an effective and safe burns service. NHS England released consensus guidance for the management of acute burns patients during the pandemic [6]. It highlighted the importance of finding a balance to ensure the proper management of burn injuries while protecting resources needed for COVID-19 management [6]. We have altered our standard management of burns during this period to encourage a more conservative approach and a reduction in hospital admissions and outpatient appointments where safe to do so [6].

The WHO advised that control of the pandemic should follow four steps; adequate preparation and detection, protecting and treating those affected, reducing the spread of transmission and finally, to innovate and learn [1]. At the time of writing this paper, there have been 9,952,507 cases of coronavirus worldwide [7] and 43,550 deaths due to coronavirus in UK [8], but new cases appear to be declining. As our department searches for a return to a new "normal" we reflect on the impact of the coronavirus pandemic on our burns service and identify lessons learnt that can help us to prepare not only for a potential second wave but also to improve the effectiveness of burn care delivery on a day to day basis.

2. Materials and methods

A service evaluation was performed which included all patients referred to our Burns Service between March 23rd 2020 and May 8th 2020. This included the peak period of the coronavirus pandemic in London. Data was collected retrospectively from patients' notes and review of theatre records. Information recorded fell into the following categories: patient demographics, mechanism of burn and relationship to the COVID-19 pandemic, time to presentation, presence of infection, need for admission, management decision and any change in this and method of outpatient follow-up. Burn infection was recorded if there were clinical signs of infection and the patient required either oral or intravenous antibiotic therapy.

In addition, a survey was given to all patients (paediatric and adult) attending outpatient appointments between May 5th 2020 and June 8th 2020. The survey asked patients how they sustained their burn, whether this was related to treatment or prevention of COVID-19 symptoms and if so where they got this advice from. In addition patients were asked if they delayed seeking medical attention and the reason for this and their preferred method of follow-up. The options given were; clinic follow-up for all dressing changes, changing dressings at home with weekly visits to the unit, managing all dressings at home and either emailing the unit with images for advice or receiving advice through scheduled video calls (Supplementary material).

3. Results

3.1. *Patient demographics*

During this period 258 new patients were seen in our outpatient clinic, 126 adults and 132 children (Table 1). The

Table 1 – Patient demographics.

		Adults	Children
Mean age in years (range)		46 (18–96)	4 (7 weeks–17 years)
Gender	Male	61	71
	Female	65	61
Co-morbidities	None	54	120
	Hypertension	19	0
	High cholesterol	5	0
	Diabetes	11	0
	Mental health	19	5
	Respiratory	10	1
	Neurological	4	1
	Other	23	5
Smoking	Smoker	15	
	Non smoker	85	
Social Situation	Lives with family or friends	83	132
	Lives alone – independent	26	
	Lives alone – package of care	2	
	Other	15	
COVID-19 Status	Not tested	115	121
	Negative	10	11
	Positive	1	
% TBSA of Burn	Mean and range	2.04 (0.01–14)	1.77 (0.1–7.5)
Burn Depth	Superficial partial thickness	52	105
	Mid-dermal	15	9
	Deep-dermal	12	0
	Mixed depth	44	16
	Full thickness	3	2

most common mechanism of burn was hot water scald in both cohorts (Fig. 1).

The patient survey was completed by 148 patients (65 children, 85 adults).

3.2. COVID-19 impact on mechanism of burns – service evaluation

Eight patients (3%) reported their burns being caused by attempting to prevent COVID-19, seven through steam inhalation and one by application of mustard seed powder to the chest. The burns caused by steam inhalation ranged from 1.5% TBSA to 3.5% TBSA in adults and 2% TBSA to 7.5% TBSA in a children.

3.3. COVID-19 impact on mechanism of burns – survey

In the survey eight patients reported sustaining their injuries in attempts to prevent COVID-19 and three in the treatment of potential COVID-19 symptoms. Patients reported getting this advice from a google search (67%), social media (22%) or family (11%).

3.4. Delay in presentation – service evaluation

3.4.1. Adults

Forty-three percent of adults captured in the service evaluation delayed seeking medical advice. The majority reported they did not initially think their burn required medical attention (36/54). The average delay was 1.9 days (maximum 41 days). When compared to pre-COVID-19 data from February 2020, the average delay was 1 day (maximum 6 days) and 37% of adults delayed seeking medical attention.

In 11 adult cases there was a delay in onward referral to our unit. The burns were initially managed locally by urgent care centres, pharmacies or general practitioners. Eight of these burns (73%) fulfilled the criteria for referral to specialised burns services. Thirteen adults with delayed presentation presented with infection and eight patients required excision and grafting of their burns. The mean time from injury to review in the burns unit was 3.1 days. This was comparable to pre-COVID-19.

3.4.2. Paediatrics

Twenty percent of parents delayed seeking medical attention for their children's burns (26/132). The reasons recorded were: not thinking the burn required medical attention (10/26), concern about catching COVID-19 (3/26) and waiting for a GP appointment (3/26). No reason was recorded in 10 cases. The maximum delay in seeking medical attention was five days.

There was a delay in onward referral in nine percent (12/132) of children. In these cases, the burns were managed by the GP, pharmacy or urgent care centre. Nine of these burns (75%) fulfilled the criteria for referral to specialised burns services. One child presented to our service with possible toxic shock syndrome and one required excision and grafting of their burn as it was full thickness. All other burns healed with conservative outpatient management.

3.5. Delay in presentation – survey

When asked in the anonymous survey 42% of adults (36/85) reported a delay in seeking medical attention following their burn injury. Concern about catching COVID-19 was the most common reason given for delay (31/36 patients). One patient delayed presentation due to self-isolation and three due to concern about hospital resources (Fig. 2). The number of children who delayed seeking medical attention was lower than that seen in adults (14%, 9/65). The most common reason reported by parents for delay was concern about catching COVID-19 (5/9) followed by a concern about hospital resources (3/9). Only one parent reported delaying presentation because they didn't feel the burn required medical attention.

3.6. Patient management

In line with COVID-19 related NHS guidance a decision for conservative management was made for the majority of burn injuries (107/126 adults, 130/132 children). Thirteen adult burns were managed expectantly with patients aware that surgery may be required; three of these burns went on to require surgical excision. Nine adults initially for conservative management were treated operatively, their burns were mid dermal (1), deep dermal (2) and mixed depth (6) and five

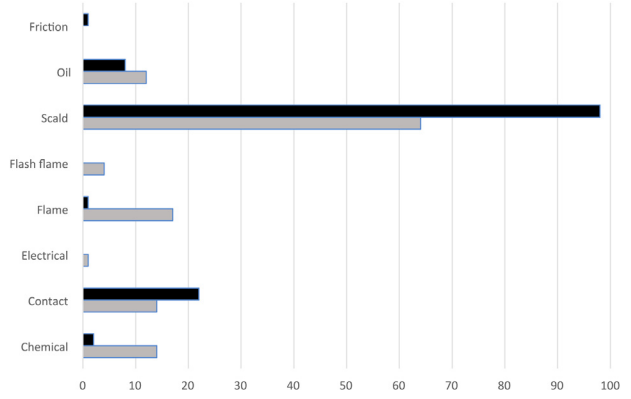

Fig. 1 – Mechanism of burn injury in adults (grey) and children (black). X Axis = number of cases.

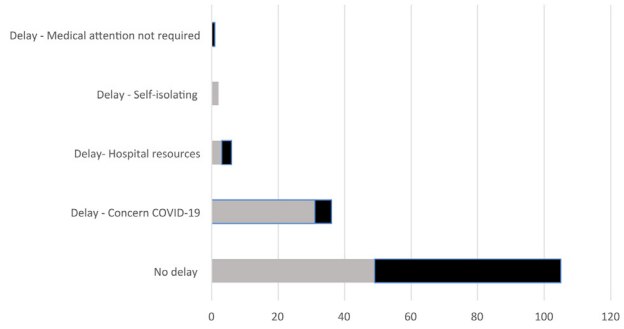

Fig. 2 – Pattern of presentation for adults (grey) and children (black) and reasons for delay in presentation. X axis = number of cases.

developed infection pre-operatively. The mean time since injury to change in management was 10 days.

One child initially for conservative management was treated surgically. The burn was assessed as mixed depth on first assessment and the management plan was changed on day eight.

Mean time to healing was 16 days in adults (31 surgical cohort, 13 conservative) and 12 days in children.

3.7. Burn management – infections

Twenty-nine (11%) patients developed burn infections, 21 at presentation, seven at follow-up and one post-operatively. Seven patients required admission for intravenous antibiotics. Of the burns admitted with infection, five were managed conservatively and one expectantly. On assessment during admission decisions were made for operative management in three of these patients due to burn progression.

The rate of infection was higher in patients with delayed presentation (Fig. 3) (23% delayed presentation, 6% not delayed).

3.8. Pediatric burns greater than 5% TBSA and superficial partial thickness in depth

Five children sustained superficial scalds greater than 5% TBSA which we would ordinarily have managed by hydrosurgical debridement and application of Biobrane® (UDL Laboratories, Rockford, IL) or Suprathel® (PolyMedics Innovations GmbH, Filderstadt, Germany). The decision for which of these dressings to apply is based on surgeons preference. Due to a reduction in theatre capacity during the pandemic a decision was made to manage these children non-operatively. The mean burn size was 6.4% TBSA (maximum 7.5% TBSA). One child was admitted for wound management (admission of three days due to pyrexia secondary to upper respiratory tract infection and for face care).

Four of the children were managed with Acticoat™ dressings (Smith and Nephew, St. Petersburg, Fl, USA) and one child with Suprathel® application following burn clean-up in our treatment room. All children had simple analgesia and oral morphine sulphate solution for dressing changes and tolerated dressing changes well with minimal pain and no itch reported. The children treated with Acticoat™ required an average of 3.7 outpatient dressing changes before healing. One child was followed up by their local burns service, the other three were healed at 7, 14- and 23-days post injury. None of these children developed infection.

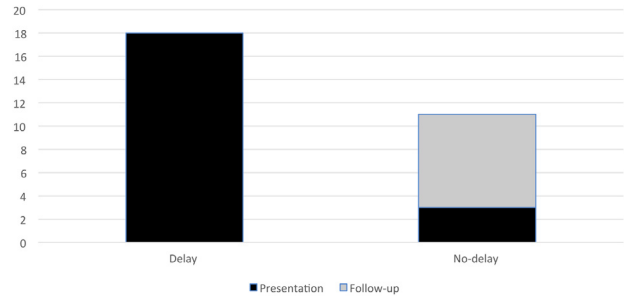

Fig. 3 – Delay in presentation and incidence of infection at presentation (black) and at follow-up (grey). Y axis = number cases.

3.9. Operative capacity

Between March 23rd and May 8th 2020, 42 operations were performed in our Burns theatre. These included 35 general anesthetic cases and seven local anesthetics. Operations were performed within five days of a decision to operate being made (mean 1.9 days). Ten operations were cancelled due to theatre staff availability, and nine of these patients were rescheduled. Following multidisciplinary discussion (between burn, anesthetic and ITU consultants) one patient was considered too high risk to operate due to their co-morbidities and the ITU resources available in light of pandemic. The mean delay in treatment caused by cancellation was 2.3 days. An average of one operation was performed per day, with a mean surgical time of 47 min. Hospital policy during this period was for all operations to be performed by the consultant to improve theatre efficiency. Operations were performed by two consultants in 19.5% of cases. Significantly more cases were performed per day in the two months pre-COVID-19 (mean 2.8, range 0–6 cases, student t-test, $p < 0.005$). Pre-COVID-19 lists typically began at 08:30; during the pandemic the average list started 146 min late (minimum 32 min, maximum 12 h 15 min). In line with hospital policy during COVID-19 and for infection control reasons patients were recovered in theatre. The mean time between cases was 119 min.

3.10. Outpatient burn management – service evaluation

Dressing changes were performed at home in 30% of children (40/132) and 34% of adults (43/126) either to decrease the frequency of outpatient appointments or negate the need for them. Home dressing changes were encouraged when deemed suitable due to size and depth of burn and patient engagement to help maintain social distancing and reduce un-necessary travel. Following their first burn assessment, patients had the option to contact our unit electronically to facilitate review of wounds and to answer dressing or burn queries. This was used by 6% (8/126) of adults and 36% (48/132) of children. Patient queries or concerns were addressed remotely without the need for additional appointments in over 90% of cases (90% children, 100% adults). Electronic review of patient images sent to the burns team with or without telephone consultation enabled the remote discharge of 35 children (27%) and five adults (4%). Twenty-two patients were managed by the outreach service, avoiding the need for hospital visits in vulnerable patients.

3.11. Outpatient burn management – survey

When asked in the survey the adult cohort favored self-management of burns dressings at home with email or video call follow-up. Parents preferred their children to be followed up in clinic (Fig. 4).

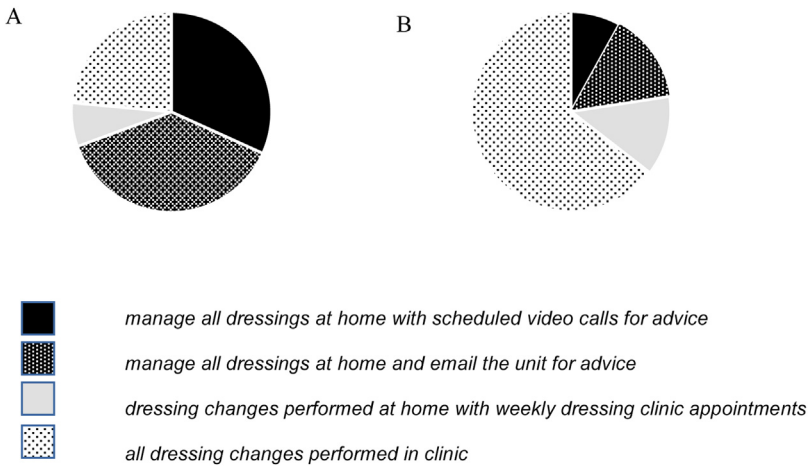

Fig. 4 – Comparison of preferred method of follow-up dressing appointments in adult (A) and pediatric (B) population.

4. Discussion

The COVID-19 pandemic has led to changes in patient presentation to our unit and our outpatient management of burns.

Public fear of catching COVID-19 has led to an increase in certain burn injuries. When asked directly in our survey 7.5% of patients seen in the outpatient department report burn injury secondary to the treatment or prevention of COVID-19 symptoms. None of these patients were COVID-19 positive Review of patient's clinic notes reported a lower incidence of COVID-19 related injuries (3.1%, 8/258), it is possible that this disparity is due to incomplete recording of mechanism of injury, for example recording that a patient sustained a scald secondary to steam inhalation but not whether they were performing this to treat a cold, a cough or for COVID-19 related reasons. The majority of COVID-19 related injuries were secondary to steam inhalation, the dangers of which are well known within the burns community. A recent letter published in the Lancet highlighted the poor evidence base for the benefits of steam inhalation as a home remedy for upper respiratory tract infections and a 50% increase in the prevalence of steam inhalation related scald injuries during the pandemic [6]. The British Association of Plastic Surgeons and the British Burns Association have both released posters highlighting the danger of injury when performing steam inhalation [9,10]. This was part of a BAPRAS prevention campaign to highlight common causes of plastic surgical trauma during the pandemic [5].

Delayed presentation can lead to burn progression, infection [11,12] and poorer long-term outcomes. A high proportion of surveyed adults (35%) and children (8%) reported delay in seeking medical attention following burn injury due primarily to concern of catching COVID-19 and 4% of all patients delayed seeking medical attention due to concern about the availability of hospital resources. In this cohort we saw almost a four-fold increase in infections requiring antibiotic treatment in patients with delayed presentations (23% vs 6%). The most common reason given for delayed presentation in patients clinical notes was that they did not consider that their burns required medical attention, this is different from the our findings in the anonymous survey which reported a concern of catching COVID-19 most frequently. It could be that the truth lies between the two, and that considering the threat of COVID-19, patients feel their injuries are insignificant. Our findings are in line with a survey of over four thousand paediatricians in the UK and Ireland which found a delay in presentation of children with sometimes serious illness during the pandemic [13]. With graphic news reports and strict messages of 'Stay Home, Protect the NHS, Save Lives', it is important we ensure the public are aware that burn injuries can be serious and the NHS is available to assess and manage them. As a burns service we also need to reassure the public we are taking adequate measures to reduce the risk of COVID-19 transmission when they attend.

There was a delay in onward referral of 12 children and 11 adults by urgent care centres, emergency departments, general practitioners and pharmacists. Although some of the burns (3/11 adult and 3/12 children) were appropriate for local management, the majority met the National Guidelines [14] for referral to or discussion with specialist burns services. It is not clear whether the initial failure to refer was due to poor assessment and local pressures or an attempt to reduce the burden on hospital services. We must ensure that those reviewing burns at first presentation are aware of the national referral criteria.

In the management of burns injuries, there are burns which clearly need surgery and those that should only be managed conservatively. Between the two extremes are a proportion of cases which can be managed operatively or non-operatively. In line with NHS England guidance [6] where conservative or expectant management was a safe option (although not necessarily the optimal management) this was considered. Sensible conversations were held with patients regarding the risks and benefits of surgery in light of the COVID-19 pandemic and the increased perioperative mortality seen in patients that develop COVID-19 [15]. The management of burns in this way helped to reduce the inpatient and operative burden on our hospital and protect patients from the risk of transmission [6]. Careful monitoring of burn healing in the outpatient setting identified burns that failed to progress towards timely healing and a decision for surgery was made at a later date in eight percent of cases. Remaining flexible to the need for changes in

management and patient education regarding this allowed us to safely manage the vast majority of our burns conservatively with acceptable healing times.

Pre-COVID-19 our protocol was to consider hydrosurgical debridement and application of Biobrane® or Suprathel® under general anaesthetic in all children with superficial partial thickness burns greater than 5% TBSA. During the pandemic, due to reduced theatre capacity and concerns regarding the safety of general anaesthetic [15], a decision was made to manage all these burns non-operatively. Four children were managed with Acticoat™ and one with Suprathel® application in our treatment room. Dressings such as Biobrane® and Suprathel® are typically favoured for treatment of these burns as they have been shown to reduce hospital stay, improve healing and decrease pain during dressing changes [16]. In our cohort, all children tolerated dressing changes well, only one required admission (3 days) and all healed within an acceptable time frame (maximum 23 days). No children developed infection. However, no children with resuscitation sized burns were referred to our unit during the pandemic and the largest burn was 7.5% TBSA. It is possible that the relatively small size of these burns may have made dressing changes more manageable. Although we only treated a small number of children in this way, we should consider reviewing our protocol for the management of these burns and consider increasing our threshold for operative management to 7.5% TBSA. Additionally, we should reconsider whether we need to give all children a general anaesthetic for Suprathel® or Biobrane® application. Although, only performed on one child in this study, we were able to safely treat a child with Suprathel® without complication using only simple analgesia and oral morphine sulphate, removing the need for general anaesthetic.

Pre-COVID-19 our unit had a dedicated daily theatre list (Monday–Friday) and 24-h theatre availability for emergency burn cases. Redeployment of staff due to the COVID-19 pandemic led to cancellation of this scheduled list and management of patients requiring surgery on a hospital wide, emergency-based, surgical specialty-shared CEPOD list. This led to a significant reduction in our operating capacity (average 1 case per day) and 24% of cases had to be cancelled and rescheduled. Despite this we were able to operate on all patients within a safe amount of time, with the maximum delay from decision for surgery to operation of 5 days (mean 1.9 days). In this case the decision to operate was made before a weekend and when the case was rescheduled it was decided safer to operate during the working week, pending no patient deterioration, when two consultants would be available. No patient was cancelled on more than one occasion. In only one case were we unable to operate due to insufficient intensive care resources to support the patient if they had post-operative complications and the high risk of general anaesthetic. The largest challenge was timing of theatre during the day and the impact this had on the time patients were nil by mouth. We noticed delays in two areas. Firstly, the logistics of staffing our dedicated theatre on the Burns Unit with staff covering a CEPOD list in main theatres led to a delay in starting the first case, especially when higher priority cases were also scheduled by other specialities. Additionally, the turnaround time between cases was around two hours due to the need to recover patients in theatre for infection control and deep cleaning. Recognising these limitations can help to plan realistic case numbers that can be achieved each day and limit the time patients are nil by mouth. Operating in full personal protective equipment was uncomfortable especially in the heat of burns theatres and masks made communication challenging.

Successful steps have been taken to reduce patient footfall within our hospital. Preventing visitors attending has reduced vectors for infection and better enabled social distancing. We have also evaluated the way patients are managed in the dressing clinic and encouraged self-dressing changes at home where appropriate and outreach for vulnerable individuals. The introduction of a virtual method of contact between patients and the burns unit especially in the pediatric population was very successful and complimented home dressing changes, providing patients with a point of contact should they have any concerns. Despite parents reporting a preference for management of burns exclusively by the unit on the patient survey, they engaged well with dressing changes at home (30% of parents performed dressings at home). Many parents sent images of wounds via a secure nhs.net email to confirm healing, reducing the number of outpatient appointments required. The benefit of this remote assessment of photographs is clear, with over 90% of concerns being resolved remotely without the need for additional appointments. Parental engagement with this process enabled 27% of pediatric patients to be safely discharged remotely. This demonstrates how good patient education can help them embrace new technologies and reduce pressure on burn services. Steps should be taken to try and achieve the same level of engagement in the adult population.

As plans are underway for a return to a new “normal” following the UK peak in COVID-19 and a relaxing of lockdown measures, we must reflect on how what we have learnt over the last few months can improve the burns service we deliver, and help us prepare for a second wave or pandemic in the future.

Firstly, the burns outreach service has been crucial in ensuring that vulnerable patients can receive high quality of burn care without exposing them to the risk of attending hospital.

Secondly, we have recognised the value telemedicine can add to our service. Although not new for our hospital our e-referral system has allowed remote triage of patients and ensured they receive appropriate initial management. Telemedicine has also enabled carefully selected patients following appropriate nurse-led education to take greater responsibility for the outpatient management of their burns. It provides the opportunity to monitor and support patients performing dressing changes at home and reduces pressure on dressing clinics. The development of robust telemedicine platforms allowing secure, high quality remote patient interaction with burns nurses/doctors following initial assessment appears to be welcome by patients and patient friendly apps should be developed further.

Thirdly, ongoing patient education is required as to the risks of steam inhalation and other home remedies for not only COVID-19 but the common cold to prevent potentially severe burn injuries. When these injuries occur, in an already anxious

population the NHS needs to ensure the public are aware that the NHS is available to see them and steps are being taken to ensure their safety. With emotive images and reports on a daily basis it is easy for patients to feel not only that their injuries are insignificant but that attendance at hospital is a threat.

The change in practise in relation to children with burns greater than 5% TBSA which was necessary as we coped with the peak of the pandemic has led us to re-evaluate the way we manage these children. We recognise that further research is needed to establish whether our threshold for surgical management with Biobrane® and Suprathel® should be increased and whether all these children require general anaesthetics.

Finally, it has been reassuring to see our service adapt and continue to deliver a safe service to our burns patients. Senior decision making has ensured careful selection of patients that definitely require operative management and those who can be managed expectantly.

Authors contribution

All authors have contributed to the conception and design of the study or the acquisition, analysis or interpretation of data. They have all contributed to drafting the article or revising it critically for important content and have approved the final version to be submitted.

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Conflicts of interest

None.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.burns.2021.01.008.

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